Installation of Ultrasonic Flow Sensor on Narkomed 4

INSTALLATION PROCEDURE

The following procedure is divided into four parts: Replacing the VPO assembly to accommodate the new ultrasonic flow sensor connector, installing a jumper assembly to power the new flow sensor, selecting the ultrasonic flow sensor function, and installing the new flow sensor on the absorber assembly.

Installing the new VPO assembly:

1. Turn the System Power switch to STANDBY and remove AC power from the machine.

2. Disable the battery circuit breaker by pulling out its button with a knife or sharp object.

3. Remove the AC power cord from the connector on the bottom of the VPO box.

WARNING: Ensure that AC power is removed from the machine before opening the VPO box cover. Failure to observe this precaution may cause injury by electric shock.

4. Remove the screws holding the cover plate over the wiring channel and VPO box, and remove the cover plate. See Figure 1.

5. Disconnect all items from the sensor interface panel.

6. Disconnect the line, neutral and ground wires from the terminals of the EMI filter.

7. Remove the two screws holding the EMI filter to the bottom of the VPO box, and remove the EMI filter.

8. Remove the screw holding the ground wire to the VPO assembly.

9. Remove the eight interface panel screws.

CAUTION: The VPO board contains static sensitive devices. Use ESD protection when handling the VPO assembly.

10. Carefully move the cabling aside to provide clearance for the VPO assembly, and remove the assembly from the box.

11. Disconnect the ribbon cable and exhaust tubing from the VPO assembly.

12. Connect the ribbon cable and the exhaust tubing to the new VPO assembly (P/N 4114430).

13. Place the assembly in the box, align the interface panels with the box cutouts and install the eight interface panel screws.

14. Connect the ground wire to the VPO assembly.

WARNING: The AC power wiring must be connected to the EMI filter in the correct polarity. Incorrect connection will compromise the electrical safety of the machine.

INSTALLATION PROCEDURE (continued)

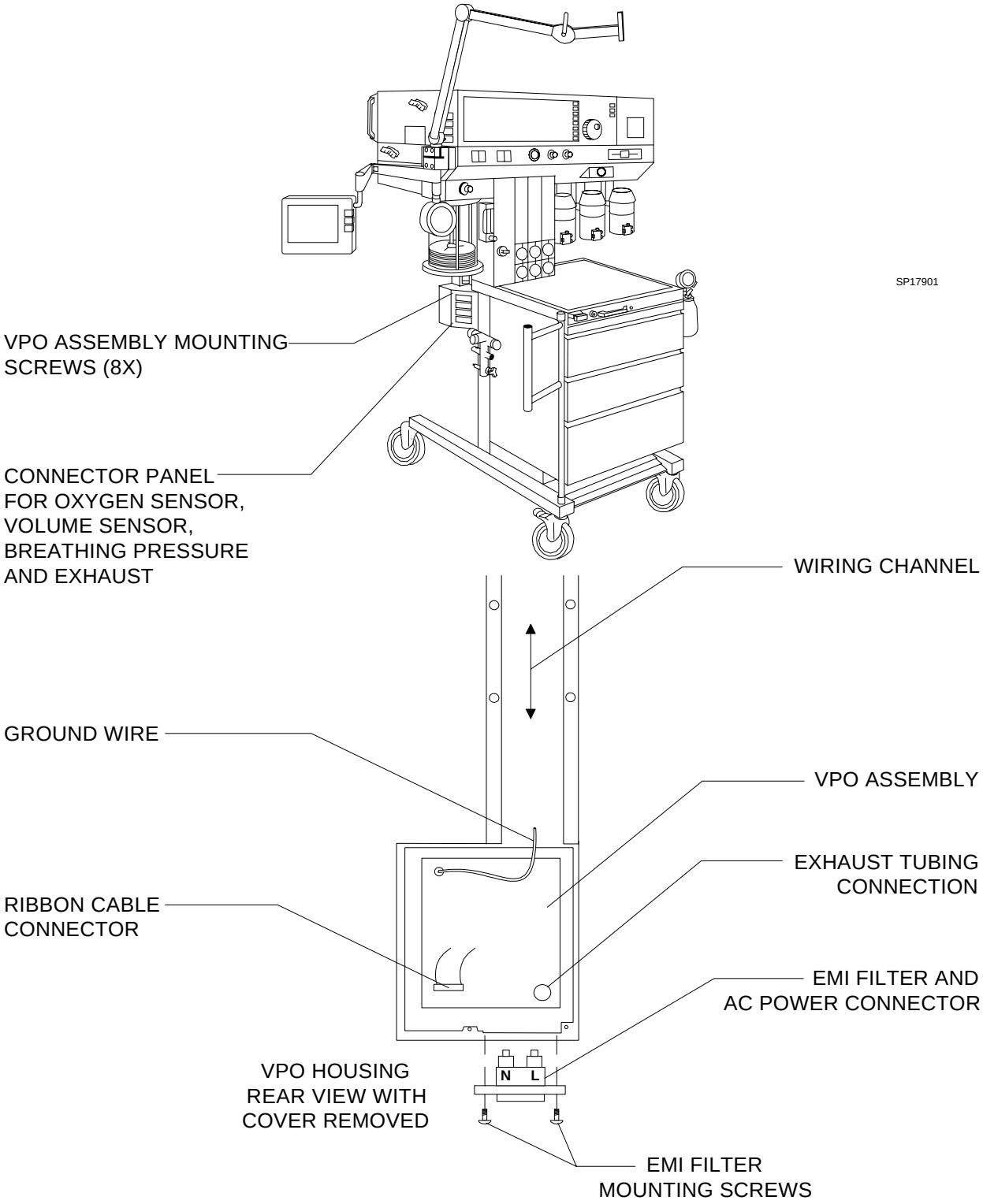

Figure 1. VPO Assembly Removal and Installation

INSTALLATION PROCEDURE (continued)

15. Install the EMI filter in the bottom of the VPO box and connect the line, neutral and ground wires to the terminals as follows:

    - Green/yellow wire to Ground terminal
    - Blue wire to Neutral terminal
    - Brown wire to Line terminal

Installing the jumper assembly:

16. Close the valves on any cylinders that are mounted on the back of the machine, and remove these cylinders.

17. Remove the ten screws holding the cover over the power supply circuit board compartment.

18. Install the wire ends of the jumper assembly (P/N 4115235) in the connector attached to J1 on the NM4 power supply PCB as follows (see Figure 2):

    - Brown wire to Terminal 6
    - Red wire to Terminal 8

19. Join the connector at the other end of the jumper assembly to the power connector from the new VPO assembly.

    Carefully route the connector wiring through the opening at the upper right side of the power supply compartment.

20. Reinstall the cover over the NM4 power supply compartment.

21. Install the cover plate over the wiring channel and back of the VPO box. Ensure that wires are routed properly and not pinched.

INSTALLATION PROCEDURE (continued)

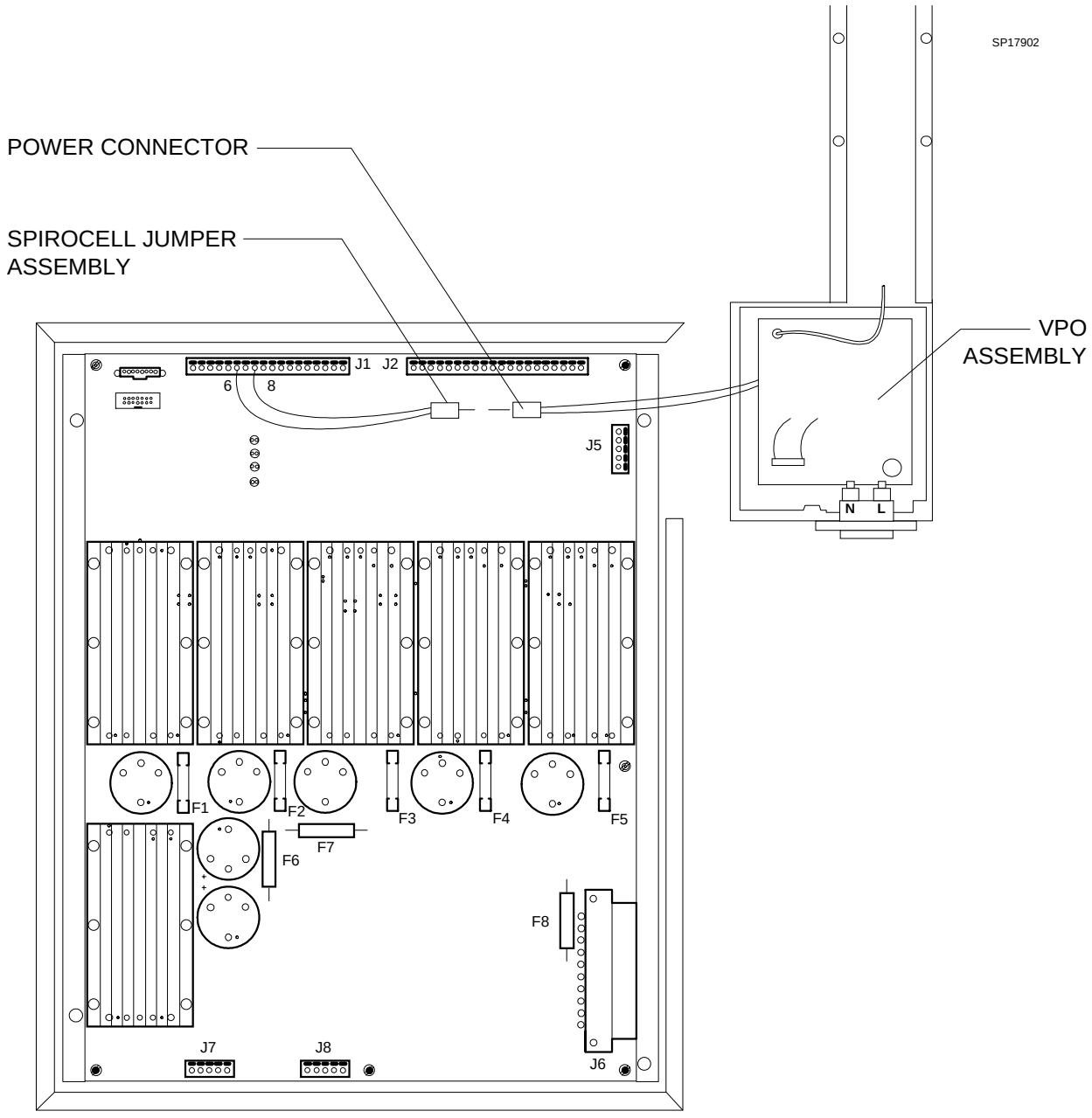

Figure 2. Spirocell Jumper Cable Installation

INSTALLATION PROCEDURE (continued)

Ultrasonic Flow Sensor Selection:

NOTE: You must load NM4 Software Version 2.10 or later, in order to use the new ultrasonic flow sensor. Refer to Section 7 of the *Narkomed 4 Technical Service Manual* for software update procedures.

The new software allows the machine to be used with either the Spiromed or the ultrasonic flow sensor.

22. Power up the machine and enter the secondary service screen. (Contact NAD's Technical Service Department for secondary service screen access instructions if needed.)
23. Touch the MACHINE OPTIONS box on the screen. See Figure 3.
24. Touch the box next to VPO FLOW TYPE under SENSOR OPTIONS.
25. Turn the rotary dial until the box displays ULTRASONIC SENSOR.
26. Touch the EXIT box when finished.
27. Press the MONITORS key on the panel to return the screen to normal functions.

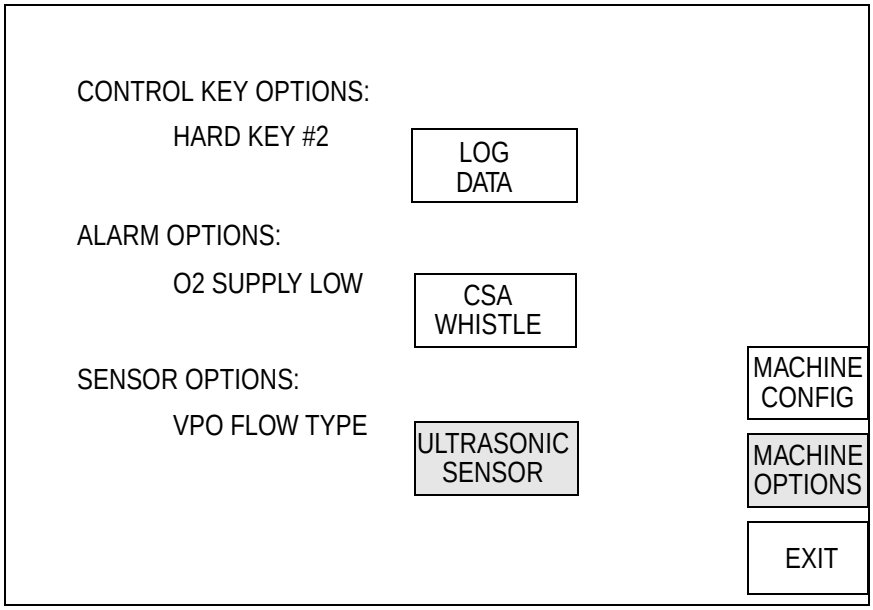

Figure 3. Ultrasonic Flow Sensor Selection

INSTALLATION PROCEDURE (continued)

Ultrasonic Flow Sensor Installation:

1. Remove the existing Spiromed sensor from the absorber assembly by unscrewing its retaining nut.

CAUTION: Do not twist the body of the sensor when loosening the retaining nut. Hold the sensor while loosening the retaining nut to prevent damage to the unit.

2. Install the new flow sensor bracket and clamp on the expiratory valve mount neck, below the threads as shown in Figures 4 and 5.

Caution: In order to avoid interference between the connector hose and the bellows assembly, the flow sensor bracket must be oriented as shown in Figure 4.

3. Reinstall the expiratory valve (be sure a gasket is in place), oriented as shown in the illustration.

4. Slide the ultrasonic flow sensor down onto the bracket.

5. Install the connector hose on the threaded port of the flow sensor, and join the other end of the hose to the expiratory valve.

6. Connect the sensor plug to the new volume sensor receptacle on the interface housing

7. Perform the tests outlined in the next section, and also a PMS procedure on the system.

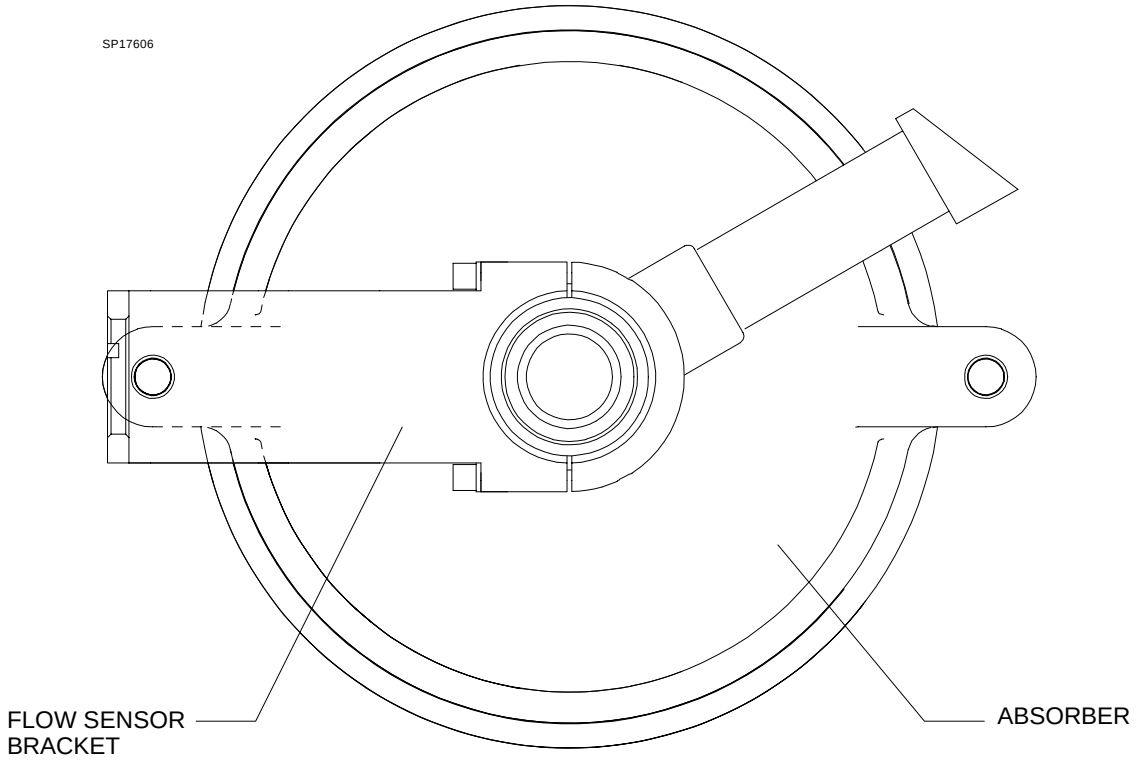

Figure 4. Bracket Orientation: Top View

INSTALLATION PROCEDURE (continued)

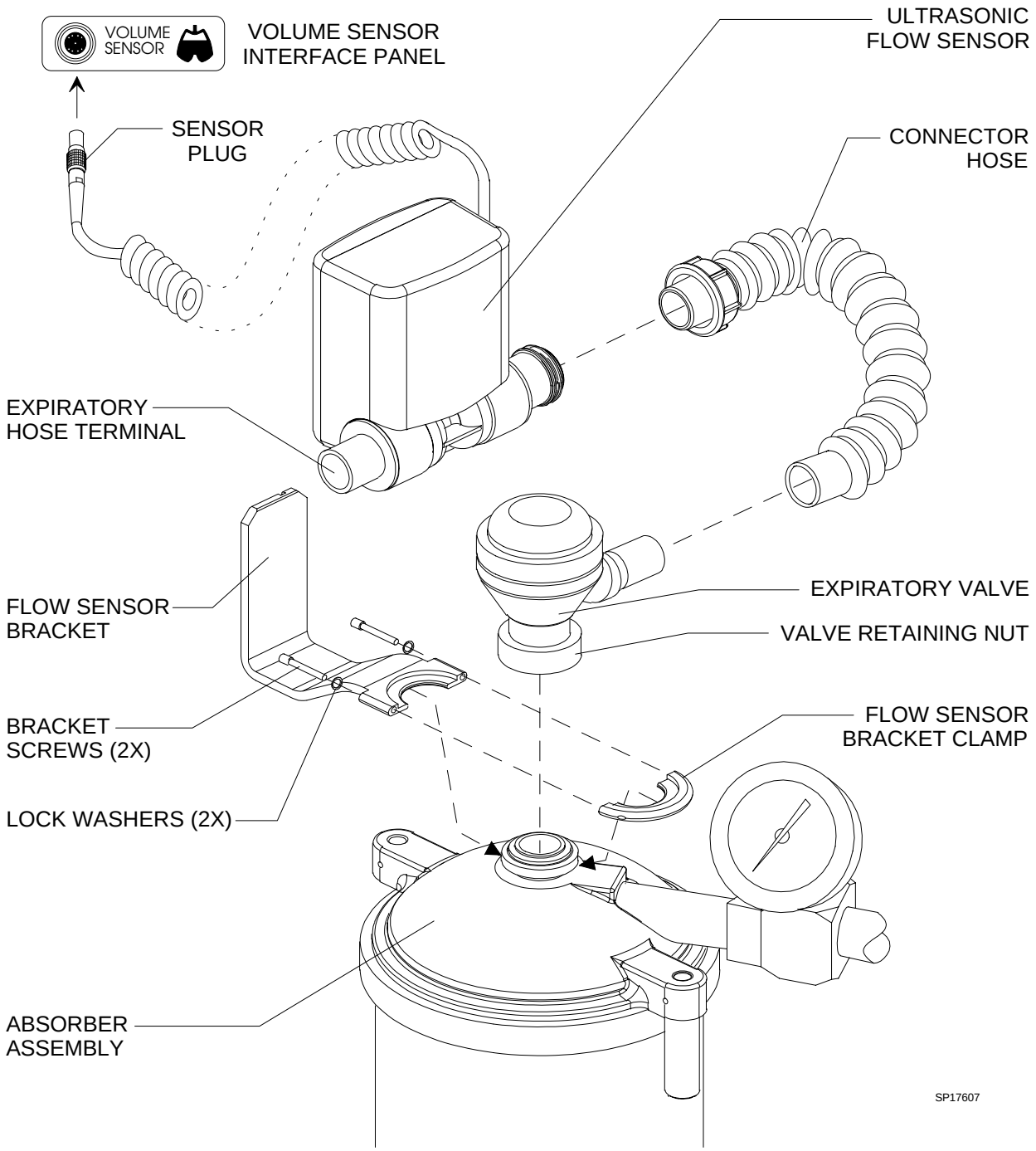

Figure 5. Ultrasonic Flow Sensor Installation

INSTALLATION PROCEDURE (continued)

Ventilator Test:

NOTE:Set the pressure limit control to MAX, and the PEEP valve to minimum if applicable. Readjustment of inspiratory flow to limit the inspiratory plateau may be required to reduce erratic tidal volumes and breath rates caused by artifact volume.

1. *Set the Man/Auto selector to BAG.
2. Set the FREQUENCY to 10 BPM.
3. Set the I:E Ratio to 1:2.
4. Set the Tidal Volume to 1000 mL.
5. Attach a patient circuit to the absorber system.
6. Adjust the O2 flow to 3 L/min.
7. Is the APNEA-P OFF messsage displayed in the Advisory column? (Y) (If no, touch APNEA ALARM ON.)
8. Is the VOL-ALARMS OFF message displayed in the Advisory column? (Y) (If no, touch VOLUME ALARM ON.)
9. Turn the ventilator on.
10. *Verify the FAULT indicator turns on (Y)
11. Set the Man/Auto selector to AUTO.
12. *Verify the FAULT indicator turns off (Y)
13. Do the APNEA-P ALARM OFF and VOL-ALARMS OFF messages disappear from the Advisory column? (Y)
14. Adjust the INSPIRATORY FLOW to the maximum of the LOW zone.
15. Occlude the Y-piece with your thumb.
16. Inflate the bellows by momentarily pressing the O2 Flush.
17. What is the peak inspiratory pressure? ___ cm H2O (>30)

* These items only apply to machines with an AV2+ ventilator.

INSTALLATION PROCEDURE (continued)

I:E Ratio and Frequency Test:

1. Attach a test lung to the Y-piece.

2. Using a stopwatch, time the inspiratory phase.

3. What is the inspiratory time? ___ seconds (1.8 - 2.2)

4. Using a stopwatch, time the expiratory phase.

5. What is the expiratory time? ___ seconds (3.6 - 4.4)

6. *Press and hold the EXTENDED RANGE switch and scroll the I:E Ratio dial counter-clockwise and verify the extended I:E Ratio values increment (2:1, 3:1 and 4:1); return the I:E Ratio to 2:1.

7. *Using a stopwatch, time the inspiratory phase.

8. *What is the inspiratory time? ___ seconds (3.6 - 4.4)

9. *Using a stopwatch, time the expiratory phase.

10. *What is the expiratory time? ___ seconds (1.8 - 2.2)

11. Adjust the frequency and I:E Ratio through the following settings and verify that the ventilator cycles properly.

Freq.	I:E Ratio	Freq.	I:E Ratio
11	1:1	66	1:3.5
22	1:1.5	77	1:4
33	1:2	88	1:4
44	1:2.5	99	1:4.5
55	1:3		

* * These items only apply to machines with an AV2+ ventilator.

INSTALLATION PROCEDURE (continued)

"F" Bellows Test:

1. Insert a calibrated volumeter between the absorber dome and the expiratory valve.
2. Set the BPM to 10.
3. Set the I:E Ratio to 1:2.
4. Adjust the O2 flow to 300 mL.
5. Adjust the inspiratory flow to MED.
6. Adjust the Tidal Volume to 200 mL.
7. What is the Tidal Volume on the test volumeter? ___ mL (125 - 250)
8. Adjsut the Tidal Volume to 1000 mL and the fresh gas to 3 L/min. Press the O2 flush momentarily to inflate the bellows.
9. What is the Tidal Volume on the test volumeter? ___ mL (900 - 1100)
10. Adjust the O2 flow to 5 L/min.
11. Adjust the Tidal Volume to maximum.
12. Remove the test lung and attach a 3 liter breathing bag.
13. Adjust the Inspiratory Flow to fully compress the bellows.

NOTE: The bag should be placed on a flat horizontal surface to reduce artifact volume.

14. What is the Tidal Volume on the test volumeter? ___ mL (≥1400)

INSTALLATION PROCEDURE (continued)

Ventilator Relief Valve Test:

1. Adjust the O2 flow to 10 L/min.
2. Adjust the inspiratory flow to fully compress the bellows.
3. Adjust the I:E Ratio to 1:3.
4. Adjust the Tidal Volume to 1200 mL.
5. What is the PEEP? ___ cm H2O (≤3)
6. Adjust the O2 flow to 500 mL.
7. What is the Tidal Volume on the test volumeter? ___ mL (1080 - 1320)
8. Does the bellows stop adjust smoothly? ___ (Y)

Flow Sensor Test:

1. Touch the MONITOR SET UP key. Does the box illuminate the MIN VOL alarm limit? (Y)
2. What is the LO MIN VOL alarm default? ___ (1.0)
3. Verify that the MIN VOL has a LO alarm limit range from 0.5 to 10.0 by increments of 0.1.
4. Adjust the LO MIN VOL alarm to 2.0 liters.
5. Touch the volume ALARMS ON to enable the volume alarms and start a stopwatch.
6. What is the time when the APNEA-VOLUME is activated under the Caution column? ___ sec (13 - 17)
7. What is the time when the APNEA-VOLUME is activated under the Warning column? ___ sec (26 - 34)
8. Turn the ventilator on.
9. Adjust the frequency to 6.
10. Adjust the I:E Ration to 1:2.
11. Adjust the flow to the maximum of the LOW zone.
12. Adjust the oxygen flow to 2 L/min.

INSTALLATION PROCEDURE (continued)

13. Adjust the Tidal Volume to 200 mL.

14. After the first breath is detected, does the APNEA-VOL in the Warning column and the MIN VOL LOW in the Caution column deactivate? ___ (Y)

15. After one minute, does the MIN VOL LOW message appear in the Caution column? ___ (Y)

16. Adjust the LO alarm limit 0.1 liter below the indicated minute volume.

17. Does the MIN VOL LOW in the Caution column deactivate? ___ (Y)

18. Increase the Tidal Volume to 1000 mL and the frequency to 10 BPM.

19. Readjust the inspiratory flow as necessary to fully collapse the bellows.

20. Is the TID VOL on the ultrasonic flow sensor and the volumeter within 20% of each other? ___ (Y)

21. Is the MIN VOL on the ultrasonic flow sensor and the volumeter within 20% of each other? ___ (Y)

22. Create a reverse flow by loosening the expiratory valve dome. Remove the breathing hose from the flow sensor. Connect a test terminal and a Riken aspirator (negative pressure squeeze bulb) to the 22 mm male port of the flow sensor. Disconnect the hose from the expiratory valve. Compress and release the aspirator.

23. Each time a reverse flow greater than 20 mL is detected, does the REVERSE FLOW message appear in the Advisory column? ___ (Y)

24. Tighten the expiratory valve dome. Remove the test terminal and aspirator from the flow sensor and reconnect the patient circuit hose. Reconnect the hose from the flow sensor to the expiratory valve.

25. Disconnect the volume sensor cord from the Volume Sensor interface.

26. Does the VOL SEN DISC and VOL ALRM OFF messages appear in the Advisory column? ___ (Y)

27. Reconnect the volume sensor cord to the Volume Sensor interface.

28. Turn off the ventilator.

29. Disable the APNEA-PRESSURE and APNEA-VOLUME alarms.

30. Remove the test volumeter and turn the System Power switch to STANDBY.

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Field Service Procedure

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